ARJUNA

JEE

LECTURE - 16

Mole Concept

Sarvesh sir

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Q. 10g of hydrogen and 71 g of chlorine were filled in a steel vessel and exploded. Amount of HCl produced in this reaction will be:

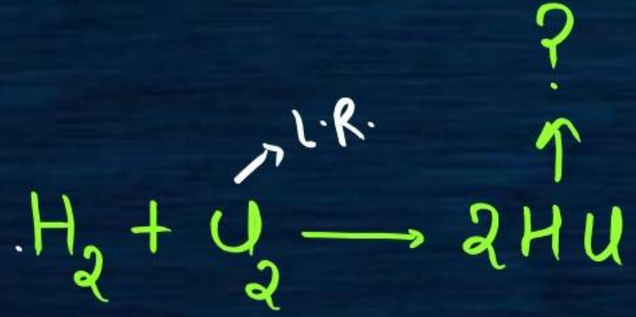
40 - 60 Sec

A 2 moles

B 3 moles

C 4 moles

D *none of these*



10gram 71gram

$\frac{10}{2} = 5$ mole $\frac{71}{71} = 1$ mole

Check L.R. $\frac{5}{1}$ $\frac{1}{1}$ → small L.R.

$\frac{(\text{mole})_{Cl_2}}{1} = \frac{(\text{mole})_{HCl}}{2}$

$\frac{1}{1} = \frac{(\text{mole})_{HCl}}{2}$

mole of HCl = 2 mole

Case-05, mixture react with reagent

Jab mixture (2 different compound) react krte hai Kisi single Reagent se

2 different Comp. (Mixture) + Reagent →

Case-1 = only comp. of mixture react with Reagent

Case-2 ⇒ Both comp. react with Reagent

(A) One reactant participate in a reaction:

An alloy of aluminium, and copper was treated with aqueous HCl. The aluminium dissolved according to the reaction:

$$2Al + 6H^+ \longrightarrow 2Al^{3+} + 3H_2$$

$2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$ $\quad \frac{\cdot 22}{22.4} = 10^{-2}$ mole

but the copper remained as pure metal. A 0.2g sample of the alloy gave 0.224litre of H_2 measured at 273 K and 1 atm pressure. What is the weigth of Al in the alloy ?

$C_{SD} = 47$ ⇒ Similar to Case of sample (impurity)

Jo Reactant reaction me participate kr raha hai Uski Ko nikal do

$\frac{(mole)_{Al}}{2} = \frac{(mole)_{H_2}}{3}$, mole of Al $= \frac{2}{3} \times 10^{-2}$ mole

amount of Al $= \frac{2}{3} \times 10^{-2} \times 27 = 0.18$ gram

amount of Cu $= 0.2 - 0.18 = 0.02$ gram

Q 2 mole mixture of Na_2CO_3 and $CaCO_3$ thermally heated at high temperature, only $CaCO_3$ decompose and release 1 mole of CO_2 gas

$$CaCO_3 \longrightarrow CaO + CO_2$$

60 sec

$$X_{Na_2CO_3} = \frac{1}{2} = 0.5$$

Calculate mole of Na_2CO_3 in mixture

(a) 1 mole

(b) 1.5 mole

(c) 0.5 mole

(d) None of these

$$CaCO_3 \longrightarrow CaO + CO_2$$

1 mole

$$\frac{(\text{mole})_{CaCO_3}}{1} = \frac{(\text{mole})_{CO_2}}{1}$$

mole of $CaCO_3$ = 1 mole

Mole of Na_2CO_3 = 2 - 1 = 1 mole

(B) Both reactant participate in reaction

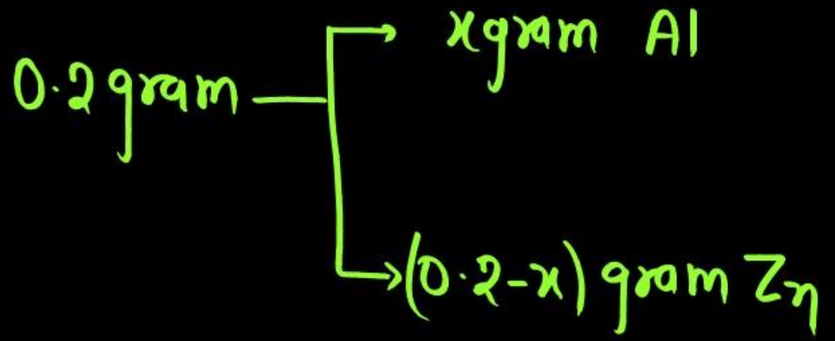
An alloy of Aluminium, and Zinc was treated with aqueous HCl. The Aluminium and zinc dissolved according to the reaction:

$$2Al + 6H^+ \longrightarrow 2Al^{3+} + 3H_2$$

$$Zn + 2H^+ \longrightarrow Zn^{2+} + H_2$$

A 0.2g sample of the alloy gave 0.23089 litre of H_2 measured at 273 K and 1 atm pressure. What is the weight of Al in the alloy ?

(a) 0.18 g
(b) 0.3 g
(c) 0.6 g
(d) 0.86 g



$\frac{0.02}{65} \times 22.4$

$C_{SD}=48$ ⇒ Jo Question me diya jaye, wahi nikal dena

$$2Al + 6HCl \longrightarrow 2AlCl_3 + 3H_2$$

$$\frac{(\text{Mole})_{Al}}{2} = \frac{(\text{Mole})_{H_2}}{3}$$

$$\frac{\left(\frac{x}{27}\right)}{2} = \frac{(\text{Mole})_{H_2}}{3}$$

$$\text{Mole of } H_2 = \frac{3}{2} \times \frac{x}{27_9} = \frac{x}{18} \text{ mole}$$

$$Zn + 2HCl \longrightarrow ZnCl_2 + H_2$$

$$\frac{(\text{Mole})_{Zn}}{1} = \frac{(\text{Mole})_{H_2}}{1}$$

$$\text{Mole of } H_2 = \text{mole of } Zn = \frac{(0.2-x)}{65} \text{ mole}$$

$$\frac{x}{18} + \frac{0.2-x}{65} = \frac{0.23089}{22.4} = 0.0103$$

$$\frac{65x + 0.2 \times 18 - 18x}{18 \times 65} = 0.0103$$

$x = 0.189$ gram

Q 184 g of $MgCO_3$ and $CaCO_3$ mixture heated at high temperature and form 44.8 Litre CO_2 gas at S.T.P., Calculate mole of $CaCO_3$ in mixture

$CaCO_3 \longrightarrow CaO + CO_2$

$MgCO_3 \longrightarrow MgO + CO_2$

(a) 1 mole

(b) 0.5 mole

(c) 1.5 mole

(d) None of these

Sol^n 184 gram → x gram $MgCO_3$

(184 - x) gram $CaCO_3$

$$\frac{(\text{mole})_{CaCO_3}}{1} = \frac{(\text{mole})_{CO_2}}{1}$$

$$\text{mole of } CO_2 = \frac{184-x}{100} \text{ mole}$$

$$\frac{(\text{mole})_{MgCO_3}}{1} = \frac{(\text{mole})_{CO_2}}{1}$$

$$\text{mole of } CO_2 = \text{mole of } MgCO_3 = \frac{x}{84}$$

$$\frac{x}{84} + \frac{184 - x}{100} = \frac{44.8}{22.4} = 2$$

$$100x + 184 \times 84 - 84x = 2 \times 84 \times 100$$

$$16x = 16800 - 184 \times 84$$

$$x = 84 \text{ gram}$$

Mass of $CaCO_3$ = 184 - 84 = 100 gram

Mole of $CaCO_3 = \frac{100}{100} = 1$ mole

1. Laws of conservation of mass

In all chemical reaction mass neither be create nor be destroyed

→ total Mass of Reactant = total Mass of product

$$2A + 2B \longrightarrow A_2B_2$$

$$[W_A + W_B] = [W_{A_2B_2}]_{prd.}$$

Limitation → all Radioactive decay does not follows law of Conservation of mass

Q 10gram of A react with 15gram of B and form 5gram A_2B and xgram AB. find out value of x

$$3A + 2B \longrightarrow A_2B + AB$$

total Mass of Reactant = total mass of product

$$10 + 15 = 5 + x$$

$$x = 20\text{gram}$$

2. Laws of definite or constant proportion

A chemical compound always contains same element with fixed proportion by mass , it does not depent upon source and method of preparation it has been obtained

or

Mass ratio of different atoms in a compound always fixed , jaye comp. Kisi bhi method se banaya gaya ho

(M-1) $C + O_2 \longrightarrow \underline{C}O_2 \rightarrow$ C : O ⇒ 12 : 32 → 3 : 8

M-2 $CO + O_2 \longrightarrow CO_2 \rightarrow$ C : O ⇒ 12 : 32 → 3 : 8

M-3 $CaCO_3 \longrightarrow CaO + CO_2 \rightarrow$ C : O ⇒ 12 : 32 → 3 : 8

Q In an Experiment 2.4 gram iron oxide an reduction with Hydrogen yield 1.68 gram of iron. In another Experiment 2.9 gram of iron oxide given 2.03 gram of iron on reduction with Hydrogen. Show that the above data illustrate the law of Const proportions.

Exp → 1

Fe : O ⇒ Fe : O

1.68 : 0.72 ⇒ $\frac{1.68}{0.72} : \frac{0.72}{0.72}$

2.33 : 1

Iron oxide = 2.4 g

Mass of Oxygen = 2.4 − 1.68

= 0.72

Fe : O

2.03 : 0.87

$\frac{2.03}{0.87} : \frac{0.87}{0.87}$

2.33 : 1

Mass of oxygen

= 2.9 − 2.03

= 0.87

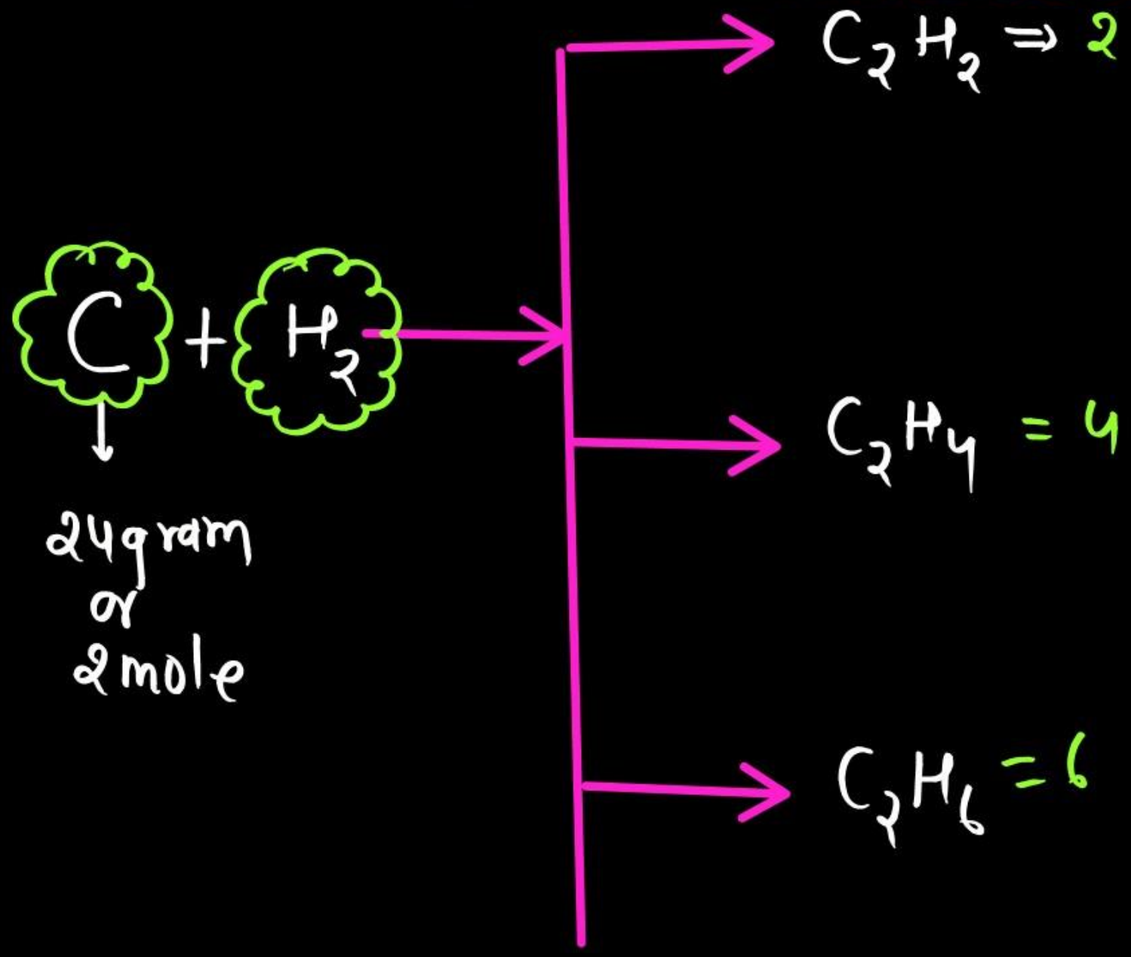
FeO

Fe_2O_3

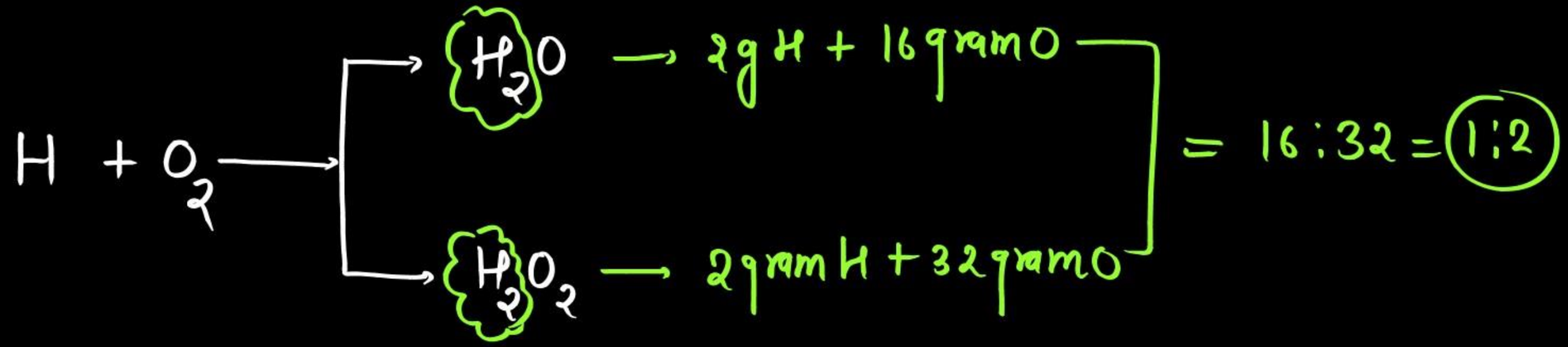
Fe_3O_4

3. Laws of multiple proportion

When different masses of one element combine with a fixed mass of other element and form different compound , bear a simple ratio of one other

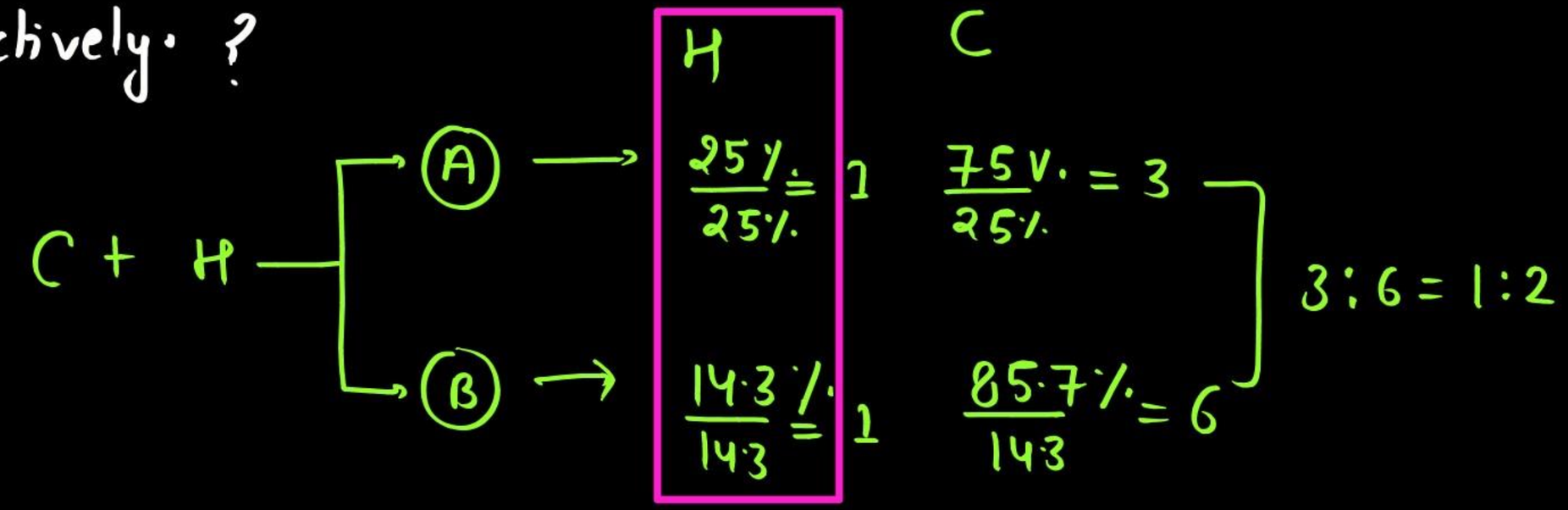


2 : 4 : 6 → 1 : 2 : 3


H + O2
H2O → 2g H + 16gram O
H2O2 → 2gram H + 32gram O
= 16 : 32 = 1 : 2

Q. Carbon combine with Hydrogen to form 2 compounds A & B, the % of Hydrogen in A & B are 25% and 14.3% respectively. ?

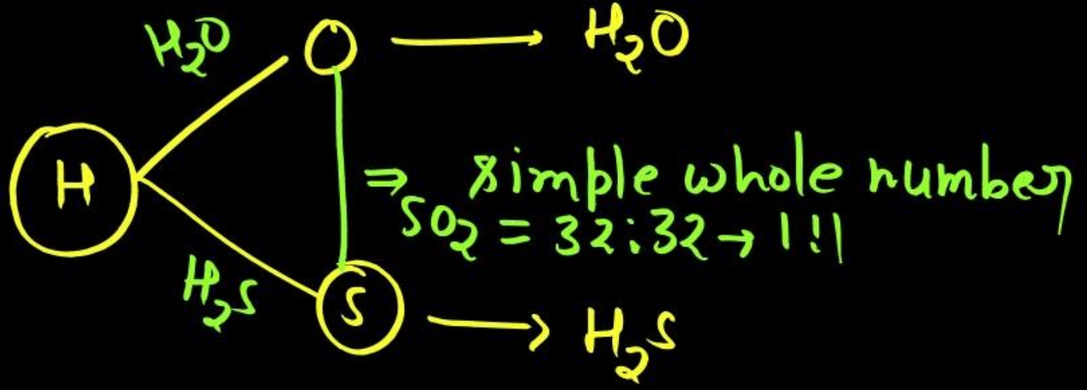
Sol^{n}



4.Law of Reciprocal proportion

Proposed by Ritcher.

- **When 2 elements combine with fixed mass of 3rd element than the ration of mass in which they of combine with each other are same or simple whole no. multiple.**



Trick.

(1) Only three elements forms three compounds.

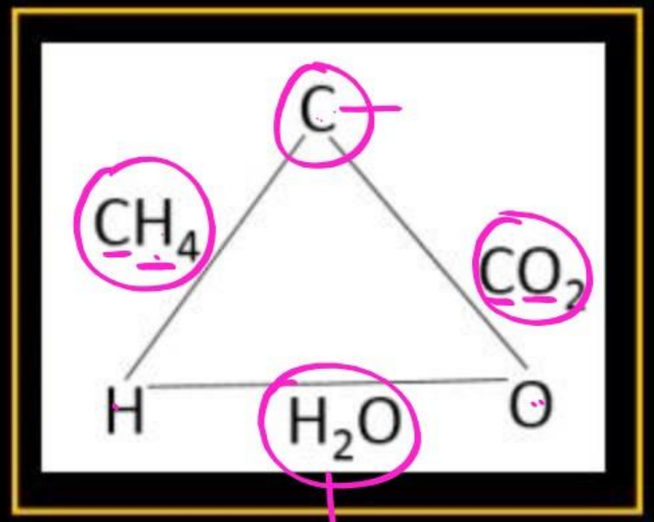
(2) One elements is common in two compounds only.

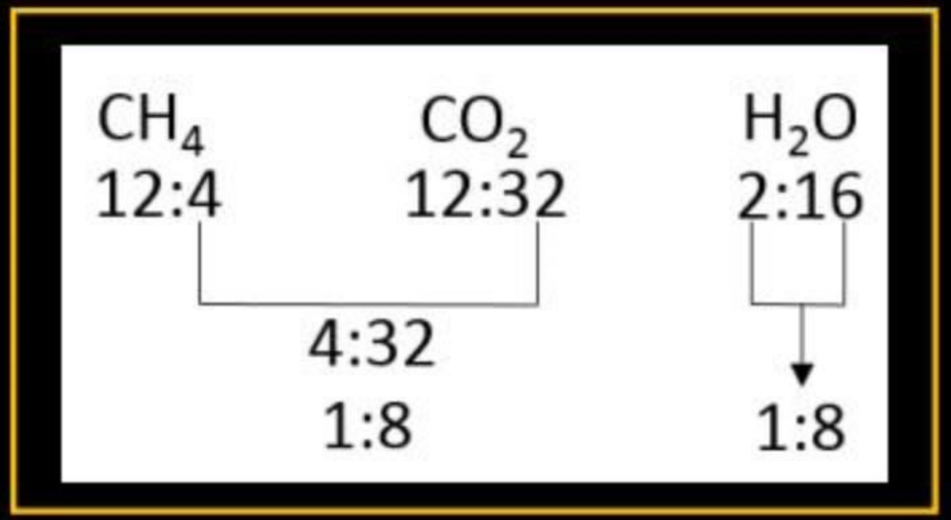
(A) H_2O , H_2S , SO_2

(B) PCl_3 , PH_3 , HCl

(C) PCl_3 , PH_3 , PCl_5

(D) PCl_5, HCl , PH_3





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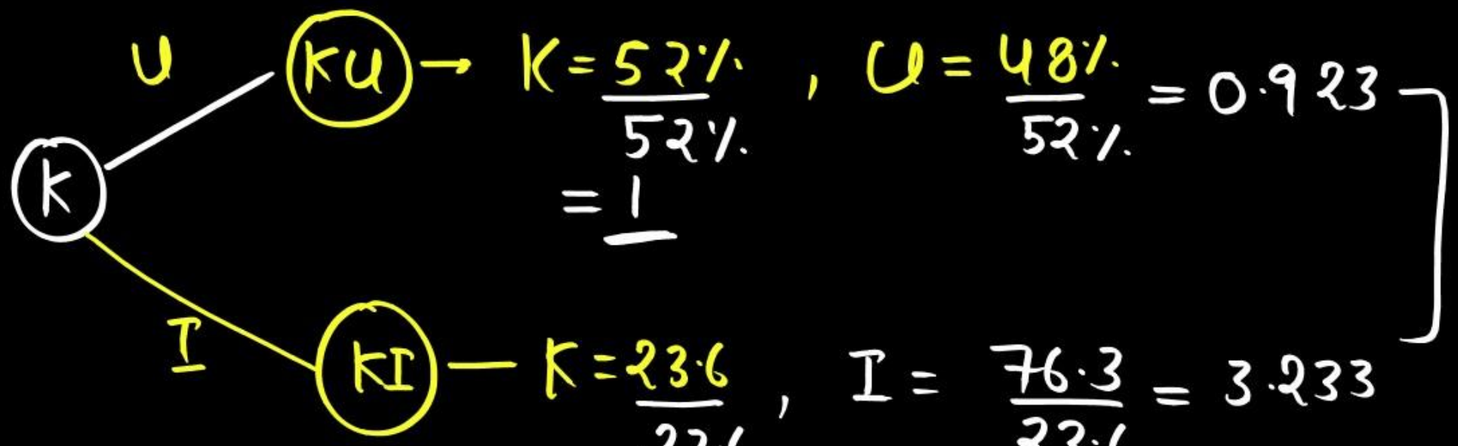
Q. KU contains 52% 'K', KI contains 23.6% 'K' and IU Contains 78.2% iodine (I_2). Show the law of Reciprocal.?



KU → $K = \frac{52\%}{52\%} = 1$, $U = \frac{48\%}{52\%} = 0.923$

KI → $K = \frac{23.6}{23.6} = 1$, $I = \frac{76.3}{23.6} = 3.233$

$U : I = \frac{0.923}{0.923} : \frac{3.233}{0.923}$

$1 : 3.5$

$U : I = 2 : 7$

IU → $I = 78.2$, $U = 21.8$ = $I : U = \frac{78.2}{21.8} : 1 = 3.58 : 1 = 7 : 2$

Home work

Home work → all DPP

pw - module (package)

Ex → 1 Complete

Thank - You